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### *Hypothesis B. Sun fainter when spotted.*

19. Twelve equidistant ordinates as before, but counting from sun-spot minimum as zero.

| Max. | 30°. | 60°. | 90°. | 120°. | 150°. | 180°. | 210°. | 240°. | 270°. | 300°. | 330°. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ·00 | ·10 | ·42 | ·85 | 1·00 | ·90 | ·74 | ·60 | ·43 | ·26 | ·13 | ·05 |

Analysing which we get :

| | A. | B. | C. | D. | E. | F. | $H_2$. | $G_2$. | $H_3$. | $G_3$. |
|---|---|---|---|---|---|---|---|---|---|---|
| Observed | +1·51 | −2·35 | −·46 | −·54 | −·23 | +·14 | +·72 | $+138^{\circ}$ | −·27 | $+236^{\circ}$ |
| Formulæ | (+1·51) | −1·67 | +·17 | −·63 | +·43 | −·08 | +·65 | +195 | −·44 | + 80 |

The difficulties of reconciling the observed quantities with the formulæ are now more serious. The H*s* agree as well as before ; but the discrepancy in $G_2$ is doubled, that in $G_3$ is as large as it can well be, and there is a serious discrepancy in B as calculated from the formula $B^2 = 8{\cdot}20 - 1{\cdot}8\ (A + 0{\cdot}20)^2$, deduced from the variable star results. Without a considerable modification of the formulæ, the sun-spot curve will not fit in with this end of the series at all.

20. We must not lay too much stress on the evidence, but so far as it goes it supports the conclusions :

(1) That the sun-spot curve falls into the series of variable-star curves, but outside the series presented by the Rousdon variables.

(2) That a maximum of sun-spot activity corresponds to a maximum of a variable star.

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## *The Rotation Period of the Planet Saturn.* By G. W. Hough.

In the *Monthly Notices* for January 1904, Mr. W. F. Denning suggests a wrong identification of the spots on *Saturn* as given in *Monthly Notices* for December, 1903. As so little is known regarding the time of rotation of the planet, the question is one of considerable importance. Of the spots observed on June 23–27 and July 13–29 there can be no question whatever. The latitudes agree very closely, and the spot was then conspicuous. And it was the only well-defined and conspicuous spot seen on the planet during the opposition. The spot observed by Burnham on August 19 was faint, and appeared to be out in latitude, and for these reasons its identity with the original spot may be questioned.

I think it highly probable, however, that previous to the middle of August the Barnard spot had lost its outline and ceased to be a well-defined object. The small spot observed on July 14, according to Barnard's micrometer measure, followed

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thirty-nine minutes. The observation of August 19 was made when the planet was only thirty minutes from the meridian, and if the spot observed was not the Barnard spot, the other ought to have been visible on the disc. If, however, the observation of August 19 is rejected as doubtful, my results for rotation period remain substantially the same.

Since the rotation period was increasing the mean period should be slightly less than when the observation of August 19 was included. A mean period $R = 10^h\ 38^m\ 24^s$ yields the following:

| Date<br>1903. | Days. | Obs. | O—E.<br>m |
|---|---|---|---|
| June 23 | −4 | Bar | +1·4 |
| 27 | 0 | Ho | +0·0 |
| July 13 | 16 | Ho | −3·0 |
| 29 | 32 | β | +1·3 |

The observations are all satisfied with a mean error $\pm 1^m{\cdot}4$.

According to Mr. Denning's identification for spot (C) $R = 10^h\ 38^m$ we have the following as given in his table:

| Date<br>1903. | Obs. | Days. | O—E.<br>m |
|---|---|---|---|
| July 6 | Ho | 0 | +10·1 |
| 18 | Ho | 12 | − 5·6 |
| 29 | β | 23 | −14·4 |
| Aug. 14 | β | 43 | + 9·9 |

We have here a range of $24^m{\cdot}5$ in the residuals. Such discordant observations would not be good for eye estimates, and certainly have no connection whatever with micrometer work. These observations obviously do not refer to the same object. Mr. Denning seems to place implicit confidence in Barnard's four observations covering a period of 21 days. On the contrary, I have great faith in his micrometer measure of June 23, which is in harmony with Burnham and myself, although it differs 6·8 minutes from his estimate.

Using Barnard's micrometer measure for June 23, from his observations we get the following, $R = 10^h\ 38^m\ 16^s$:

| Date. | Days. | O—E.<br>m | Date. | Days. | O—E.<br>m |
|---|---|---|---|---|---|
| June 23 | 0 | +0·0 | July 13 | 20 | +1·1 |
| 24 | 1 | +6·6 | 14 | 21 | +0·0 |

which is in confirmation of my value for the rotation period.

I am somewhat surprised that such an experienced observer as Mr. Denning, who has done so much good work on the planet *Jupiter*, should raise the question of the rotation period of the planet *Saturn* with the kind of material at his disposal.

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The Barnard spot was observed on five nights by two or more observers.

The following is the range in the time of passage over the central meridian :

| Date 1903. | Range. m | Date 1903. | Range. m |
|---|---|---|---|
| June 26 | 19 | July 24 | 17 |
| July 11 | 25 | Aug. 5 | 20 ? |
| 12 | 20 ? | | |

These figures imply an uncertainty of about ten minutes in the time of passage over the central meridian. During this period the spot was a conspicuous object.

In 1878, before the rotation period of the red spot on *Jupiter* was ascertained we had very much the same kind of uncertain observations.

Mr. Denning's suggestion that discordant observations may be due to oscillation in position of the spots on *Jupiter* and *Saturn* is not sound. There is no proof that any spot on *Jupiter* has changed the direction of its motion in a short interval of time. The smallest spot observed has an area of more than one million square miles, and those usually observed many times that area. Presumably there is mass, and according to our ordinary conception of matter in motion we should not expect any sudden stoppage or reversal of motion.

As between micrometer measures on a luminous disc and eye estimates, at this late day, there ought to be no difference of opinion.

The micrometer method for ascertaining the passage of a spot over the central meridian of *Jupiter* was used by Airy in 1835. At that time the chronograph was unknown and the parallel wire micrometer little used. Airy located the spot by transits of the limbs of the planet and spot by the eye and ear method as in meridian observations.

In 1879 I made a few observations of the red spot in the same way, using the chronograph.

I found, however, that much time was saved and greater precision secured by making the measures directly with the micrometer.

It is to be hoped that if any definite spots are seen on *Saturn* at the coming opposition, astronomers who have micrometers will use them, and determine both longitude and latitude at each observation. Two sets of measures of three bisections of the spot and the limbs of the planet, with the corresponding times when the spot is near the central meridian, will give the time of passage over the central meridian by simple proportion.

During the fifteen minutes employed by the observer in watching a spot in transit one may make from twenty to forty micrometer readings.

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When observers on the same night differ in the estimated time of passage fifteen or twenty minutes, it is evident that the method is not a good one. Observers who have no driving clock or micrometer must necessarily do the best they can, but it ought to be evident to every working astronomer that the quality of the work cannot be the same for all instruments.

*Dearborn Observatory of North-Western University:*
1904 *April* 2.

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## *Corrected Continuation of Brünnow's "Tafeln der Flora."*

### By A. M. W. Downing, D.Sc., F.R.S.

The materials collected in this paper are intended for the convenience of astronomers who may wish to use the corrected elements of *Flora*, published in *Monthly Notices*, vol. lii. p. 590, in combination with Brünnow's Tables, for the purpose of computing an ephemeris. By means of the continuations or modifications of certain of the tables, or of parts of them, here given, the necessary computations can be made with facility for the period 1904–1911.

From an observation of the planet made by Mr. Tebbutt at Windsor, N.S.W., on 1902 July 27, and published in *Astron. Nachrichten*, No. 3856, I find the correction to the place of *Flora*, computed in the manner indicated above, to be

in R.A. $-3^{s}{\cdot}85$, and in Decl. $-13''{\cdot}3$.